Environmental Enrichment for Captive Animals

Robert J. Young

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for Captive Animals

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Preface

This book is born out of my research and practical experience of environmental enrichment. I have tried to write a book that is scientifically rigorous but also practical. First and foremost, I believe that anyone involved in environmental enrichment needs a good basic understanding of animal welfare and the scientific evidence that environmental enrichment does indeed improve animal welfare. However, I did not wish to write a solely theoretical book as these already exist (Shepherdson *et al.*, 1998) and I feel that such theorising is more appropriately published in peer-review journals. The other danger is to go too far the other way and write a practical implementation book, but these also already exist (Field, 1998). Instead, I have opted for the rather more perilous middle path – the hybrid. Really in order to meet the needs of my intended audience. This book is designed for the reader who wishes not only to implement environmental enrichment but also to understand how it actually improves animal welfare. The book is not aimed at the academic researcher in animal welfare, nor is it for those who only want a list of enrichment ideas for the species in their care. The book is not example driven but goal and strategy driven, because there are simply too many species on this planet to cover, more than 4000 mammal species alone.

The content of the book reflects the need for scientific knowledge and practical application of this knowledge. I have based the chapters on those subjects about which I am most frequently questioned either in academic or practical circles. For example, Chapter 12 on 'Designing and Analysing Enrichment Studies' results from the large number of people who have requested this information, principally zoo biologists and university students.

I have also tried to convey much of my own personal experience, both academic and in implementing environmental enrichment. On too many occasions I have visited institutions where people have tried to convey the right scientific and practical information about environmental enrichment but without either sufficient interpersonal skills or enough understanding of the situation to do so effectively. To be serious about the application of environmental enrichment or any animal welfare related subject, you must also be serious about human psychology. It is

only by understanding the people who work with animals that environmental enrichment can be successfully implemented. One can have the best academic mind about the subject and the best practical skills for implementation, and yet these will count for nothing without the ability to understand, communicate with, learn from and educate those working with animals.

I regard this as a 'how to' book – by their nature such books are filled with instructions. This book has its fair share of these instructions, but also includes a significant amount on basic principles. Finally, I have tried to write in an accessible style and have in many places given full explanations of concepts rather than simply referring the reader to other literature. This being said, I have often summarised concepts for the sake of brevity, and therefore I highly recommend that, whenever possible the interested reader uses this book in conjunction with the primary sources of information.

This book should not be judged on its sales or academic reviews but by how it is used by the people who read it. My hope is that it may help the more academically minded person produce environmental enrichment that is not only scientifically valid but, importantly, practical. Conversely, I hope that this book will enable those who favour a more practical approach to increase the scientific validity of their environmental enrichment work. Ultimately, I hope this book will result in the much wider application of environmental enrichment that improves animal welfare.

Rob Young
Belo Horizonte, Brazil
February 2003

Field, D. A. (1998) ABWAK *Guidelines for Environmental Enrichment*. Top Copy, Bristol.
Shepherdson, D.J., Mellen, J.D. & Hutchins, M. (1998) *Second Nature*. p. 350. Smithsonian Institution Press, Washington.

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I have had the good fortune to work with Valerie Hare, from The Shape of Enrichment, who has boundless energy for motivating people about the subject of environmental enrichment. I wish I could tap into her energy source.

Academically, I have had many fruitful and enjoyable discussions about environmental enrichment with Jim Anderson, Hannah Buchanan-Smith, David Field, Trevor Poole, David Shepherdson, Miranda Stevenson and Natalie Waran. Alistair Lawrence as my PhD supervisor set me on this path of interest in animal welfare – an interest that also benefited enormously from the courses I received in animal behaviour from Chris Barnard and Pete MacGregor. I owe a huge debt to the many students I have supervised over the years on environmental enrichment projects, and it is this experience that has been used to construct the content of many chapters.

This book was started while I was working at De Montfort University, Lincoln, UK (my old department is now in the University of Lincoln). At DMU, I thank Daniel Mills and Jonathan Cooper for the many conversations we had about animal welfare. I also thank all of my colleagues for their support: Gary, Jill, Joy, Sarah, Rachel, Stephen and Frank. The book was finished whilst working for my

present employer PUC-Minas, to whom I am grateful for support and giving me the time to write the book. I would like to thank my colleagues for their support: Adriano, German, Hugo, Nilo, Sonia, Enemir, Thaísa, Maria Tereza and Gilmar.

I owe a debt to UFAW for suggesting me as an author, to Guy Salkeld and Antonia Seymour for being my editors at Blackwell Publishing, and to James Kirkwood, Robert Hubrecht and Elizabeth Roberts at UFAW for understanding the scientific mind!

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Environmental Enrichment: an Historical Perspective

1

In 1985, the Congress of the USA passed amendments to the *Animal Welfare Act* that directed the Animal Plant and Health Inspection Service (APHIS) to promulgate regulations that provide for the psychological well-being of non-human primates (Bloomsmith *et al*., 1991). In February 1991, the US Drug Administration/APHIS issued a final ruling that states: 'Dealers, exhibitors, and research facilities must develop, document and follow an appropriate plan for environment enhancement adequate to promote the psychological well-being of non-human primates'.

In the UK, while environmental enrichment is not a legal requirement in animal keeping institutions (i.e., farms, laboratories and zoos), it certainly helps to justify laboratory animal experiments (see Chapter 7) and in the UK, zoo visitors expect to see it being implemented (Reade & Waran, 1996). Personally, I have run workshops and courses on this subject from countries as diverse as Brazil and Russia. Television programmes about animals in the UK often feature stories about how to enrich the lives of pet species (see Chapters 7 and 13). How did we arrive at this heightened level of interest in environmental enrichment? A historical perspective is very useful on any subject matter, since knowing where we have come from often determines where we should go. However, before starting we need to define what we mean by environmental enrichment.

1.1 Definitions

'Environmental enrichment is a concept which describes how the environments of captive animals can be changed for the benefit of the inhabitants. Behavioural opportunities that may arise or increase as a result of environmental enrichment can be appropriately described as behavioural enrichment' (Shepherdson, 1994).

Alternatively, environmental enrichment is 'a process for improving or enhancing zoo animal environments and care within the context of their inhabitants' behavioral biology and natural history. It is a dynamic process in which changes to structures and husbandry practices are made with the goal of increasing behavioral choices to animals and drawing out their species appropriate behaviors and abilities, thus enhancing animal welfare'. (BHAG, 1999, provided by Valerie Hare).

1.1.1 Goals

In terms of practically implementing environmental enrichment it is easier to think of its goals rather than the various definitions that exist (see above). The goals are to:

(1) increase behavioural diversity;
(2) reduce the frequencies of abnormal behaviour;
(3) increase the range or number of normal (i.e. wild) behaviour patterns;
(4) increase positive utilisation of the environment;
(5) increase the ability to cope with challenges in a more normal way.

(Modified after Shepherdson, 1989; Chamove & Moodie, 1990)

1.1.2 Types of enrichment

Environmental enrichment is a term that applies to heterogeneous methods of improving animal welfare that includes everything from social companionship to toys. Bloomsmith *et al*. (1991) identified five major types of enrichment, each of which can be subdivided:

(1) Social
  (1.1) Contact
    (1.1.1) Conspecific (pair, group, temporary, permanent)
    (1.1.2) Contraspecific (human, non-human)
  (1.2) Non-contact
    (1.2.1) (visual, auditory, co-operative device)
    (1.2.2) (human, non-human)
(2) Occupational
  (2.1) Psychological (puzzles, control of environment)
  (2.2) Exercise (mechanical devices, run)
(3) Physical
  (3.1) Enclosure
    (3.1.1) Size (alteration)
    (3.1.2) Complexity (panels for apparatus)
  (3.2) Accessories
    (3.2.1) Internal
      (3.2.1.1) Permanent (furniture, bars)

(3.2.1.2) Temporary (toys, ropes, substrates)
(3.2.2) External (hanging objects, puzzles)
(4) Sensory
(4.1) Visual (tapes, television, images, windows)
(4.2) Auditory (music, vocalisations)
(4.3) Other stimuli (olfactory, tactile, taste)
(5) Nutritional
(5.1) Delivery (frequency, schedule, presentation, processing)
(5.2) Type (novel, variety, browse, treats)

In Chapters 8–11 I discuss all the different types of enrichment and strategies for implementing them for any species of animal held in captivity. The origins of animal keeping, animal welfare and environmental enrichment are pertinent to the types of enrichment we might use and, therefore, these subjects are discussed in the remainder of this chapter.

1.2 A Short History of Animal Keeping

The origins of zoos have been extremely well documented by Bostock (1993) in his book *Animal Rights and Zoos*. To summarise briefly, the first major collections of exotic animals were housed by the ancient Egyptians (around 3000 BC). These collections were maintained for two broad reasons: (1) many of the species kept had religious significance; (2) the possession of exotic animals was regarded as a status symbol. The use of animals as status symbols by rich and royal families across Europe and the Middle East continued until around 1800. In London, the Tower of London housed the royal family's collection of exotic animals, which had included lions and polar bears (which were often presented as gifts). Then, in the early 1800s, scientists such as Darwin started to take a serious scientific interest in the Animal Kingdom, especially in classifying animals into related groups (i.e., systematics). To facilitate their work these scientists needed large collections of different species and ones that could be easily observed (this meant small barren enclosures). It was at this time in London that the royal animal collection was moved from The Tower to Regent's Park. Sir Stamford Raffles founded London Zoo in Regent's Park in 1826. For the first twenty years of its life the zoo was only open to *bona fide* scientists before finally allowing entrance to the fee paying public. Soon after the public was given access to London Zoo, letters of complaint and criticisms of the high death rates of the animals started to appear in *The Times* newspaper. The animals were largely dying from physical health problems, such as disease. The zoo responded to the problems by increasing levels of hygiene and ensuring that all newly built enclosures could be easily cleaned (this meant hard surfaced, small barren enclosures – now referred to as hard architecture) – conditions that still exist in many zoos today despite advances in veterinary medicine

and despite the work of Hagenbeck on the design of naturalistic enclosures (see below).

Unfortunately for zoo animals, zoo architecture often followed trends in human architecture. In the UK in the 1960s functionalism and constructions of reinforced concrete were in fashion for human architecture. Thus, architects such as Berthold Lubetkin were designing both high-rise flats for humans and zoo-animal enclosures (much of his work can still be seen in Dudley Zoo, UK). It was not until the 1960s with the growing interest in animal welfare (spurred on by Ruth Harrison's (1964) book *Animal Machines*, see below) and the recognition of the need for conserving species from extinction by captive breeding, that many zoos developed more animal-welfare-friendly enclosures. This is despite the fact that some zoos had for many years recognised the potential for animal suffering. The archives of Edinburgh Zoo contained copies of all the annual reports produced from 1909 (before the zoo opened) to the present day. These reports make interesting reading; I have picked out below some relevant extracts to demonstrate the evolution of zoos:

1911 A paper was presented to the zoological society which suggested that if the zoo acquired polar bears it would have to provide toys and other objects as outlets for this species' well-known playful and exploratory behaviour.

1930s The zoological society discussed the building of a tiger enclosure with an undulating front to prevent the tigers from performing their well-known parading up and down behaviour.

1950s The zoo received criticisms in newspapers for overcrowding in the bear enclosures.

1960s The language in the annual reports became more scientific and the animals were no longer referred to as 'the inmates'. At the same time, animals were no longer referred to by their given names.

1973 The first environmental enrichment study was conducted in the zoo by a student (Charles Watson) from the University of Edinburgh.

1981 The chimpanzees were group-housed in a large enclosure with an artificial termite mound.

1990s Many studies on behaviour and environmental enrichment were reported as being conducted within the zoo.

It is sobering to reflect on some of the significance of these extracts, particularly that for 1911 and the fact that most zoos did little about polar bear enrichment until the 1980s (Ames, 1993). The 1930s report is clearly an unconscious reference to stereotypic route pacing, which clearly was unpopular with the visitors or why else would the zoo seek to eliminate it. A study by Lyons *et al.* (1997) has shown that this enclosure is successful at preventing the expression of pacing behaviour but this does not mean an improvement in animal welfare (see Chapter

3). The first observations of stereotypic behaviour in zoo animals were made at this time in Germany (Meyer-Holzapfel, 1968). The reasons why ideas or information that could improve animal welfare took so long to implement are unclear. (I speculate that it probably relates to the greater public awareness of animal welfare in the 1960s, and some people have suggested that the proliferation of wildlife documentaries at this time caused a change in public attitudes. It is ironic, however, that many wildlife documentaries use zoo animals for their close-ups or when they wish for a visually spectacular behaviour pattern.)

The present trends in zoo enclosure designs in western countries tend to reflect the roles of the modern zoo, in conservation, education, research and recreation (Kreger *et al*., 1998). For example, in the US and Europe naturalistic enclosure designs are now popular because they facilitate environmental education programmes, i.e. they place the animal in the context of its environment. Today, the conservation work of zoos is co-ordinated by national (e.g. American Zoo and Aquarium Association) and international organisations (e.g. World Zoo Organisation). The main challenge facing zoos today is to house animals in enclosures that, as Tudge (1992) put it, conserves the whole animal (i.e. behaviour as well as genes). Environmental enrichment has a significant role to play with respect to this.

Humans (*Homo sapiens*) and human ancestors (e.g. *H. habilis*, *H. erectus* and Neanderthals) have been exploiting animals for food for at least two million years. Animals were principally exploited by hunting until relatively recent times (16 000 years ago) when some modern humans desisted from their nomadic hunter-gatherer lifestyle and commenced farming in one location (Passariello, 1999). The next significant advances were made when the first animals were domesticated, since domesticated animals are much easier to manage. Domestication is basically a process whereby a species becomes adapted to living with and being managed by humans. This undoubtedly involved the selection of various behavioural, physiological and morphological traits. A key trait would be reduced fear of humans. Such traits that arose during early domestications are likely to be the by-product of the process (i.e. those sheep with less fear of humans produced the most offspring) rather than a deliberate selection policy by ancient farmers. The domestic sheep was the first food animal to be domesticated (from the Asiatic mouflon) around 9000 years ago in the Middle East. Once humans had a species 'tamed' in captivity they could then start deliberate selection for desirable characteristics, such a fast growth rate and large body size. There is evidence that sheep were being selected for particular coat characteristics 8000 years ago (Pond, 1994). The world population was five million people at the time farming of animals commenced. 8000 years later it was 500 million and during the last millennium it increased to more than five billion people, having tripled between 1900 and 2000. Over this long period of time agricultural practices gradually evolved and became more refined, and species were continuously selected for traits useful to humans, e.g. increased litter size in pigs (Pond, 1994). The next major change in agricultural practices came after 1945. During the Second World War (1939–45) the UK

discovered it needed to import food from the US as it was not self-sufficient in food production. After the war politicians regarded self-sufficiency in food production as essential to national security and encouraged farmers to find methods of producing more food but on the same amount of land. This gave rise to intensive systems of animal husbandry, which have been heavily criticised for their animal welfare standards (e.g. Harrison, 1964). Food from intensive farming systems was popular with the general public because it was cheap to buy. Much of the farm animal husbandry and enclosures we have today are the result of this pressure to be self-sufficient in food. Of course, public concern has created some changes, for example, the UK ban on keeping pregnant pigs in small metal crates (tethered to the crate by a short chain) and the ban on battery-cage egg production in Switzerland. However, alternative production methods produce smaller profits (Bennett, 1997) and often a premium priced product. In the UK, the Royal Society for the Protection of Animals (RSPCA) endorses high-welfare farms with the 'Freedom Food' label allowing farmers to sell their product at a premium (Kells *et al*., 2001).

The first animal to be domesticated was the domestic dog, from the Asiatic wolf, around 12 000 years ago in the Middle East. The process of domestication probably started with some wolves approaching close to human settlements and being fed. Humans quickly realised that wolves could prove to be useful 'look-outs' and had the potential to help with hunting animals. Over a period of time the wild wolves became tamed and the process of domestication began. There is archaeological evidence that different breeds of dogs existed 10 000 years ago. Pet breeds of dogs almost certainly were bred from dogs kept as working animals, i.e. dogs were domesticated to work for humans and then became pets – they were not domesticated to be pets (Passariello, 1999). The ancient Egyptian pharaohs kept several breeds of dogs as long ago as 1900 BC. The Chinese emperors had the pekinese breed created for them at least one thousand years ago. There now exist more than 400 breeds of dog. Over the course of the human–dog history, the environment of the dog in western countries has become much more restrictive, i.e. most dogs are restricted to their owners' house except during exercise. However, it would be wrong to think of pet-keeping as a western-society tradition: explorers discovering and charting North and South America in the 1600s and 1700s found pet-keeping to be common among indigenous peoples. The number of exotic species being kept as pets in Western societies has been rising steadily since the 1960s. Many of these species, such as reptiles, have highly specific housing and husbandry requirements to experience a good level of animal welfare. Pets in general are the forgotten animals of public concern in animal welfare (see Chapter 7) and may experience a low level of well-being, especially psychological.

Science only started to become a major force in changing human lifestyles during the period of the Industrial Revolution (1820s onwards). It was only really with the drive to develop modern medicines that animal laboratory-houses were first

established – the earliest ones were in universities that taught medicine or veterinary science. These animals were largely used in anatomical investigations. The publication of *The Origin of Species* by Charles Darwin in 1858 drew the scientific communities' attention to the fact that animals could make good models for understanding human biology. Only during the 20th century was the possibility of using drugs to cure many diseases fully realised. To do their medical research, to develop new drugs, scientists needed animals – often lots of them. The use of animals in experimentation had grown to such an extent by the 1920s that it was heavily criticised by Albert Schweitzer (1875–1965 – see below). In 1947, the Universities Federation for Animal Welfare published the first book on the management and care of laboratory animals. Today millions of animals are used each year for research in laboratory animal-houses, between three and four million in the UK alone. Laboratory animal-houses have improved greatly since the growing public awareness of animal welfare in the 1960s. However, the rate of improvement is not uniform across the globe as it tends to be society driven in those countries whose people express the most concern about animal welfare, e.g. western Europe. In the UK, the level of action against animal laboratories by animal-rights groups has forced most laboratories to be designed like fortresses, thereby denying animals the best housing conditions. For example, laboratory primates in the USA are regularly housed with extensive outdoor enclosures (Eichberg *et al*., 1991; Kessel & Brent, 2001). This is something that cannot be done in the UK because of animal-rights activists whose actions have included taking animals from laboratories, and even releasing mink (highly destructive predators) from farms into the British countryside.

The welfare problems of captive animals are often thought to be the product of modern systems of animal housing. We never imagine that beneath the Coliseum in Rome lions paced up and down in their tiny cells, or that sheep housed in a rock-walled pen chewed each others wool, or even that the Chinese emperor's pet pekinese howled when left alone. However, animal welfare scientists know that if we recreated historical housing conditions for farm, zoo or pet animals, these animals would suffer welfare problems. Unfortunately, we have no direct evidence of the level of animal-welfare experienced by animals more than a few hundred years ago. The best indirect evidence we have are teeth wear patterns from the skulls of several-thousand-year old horses – these wear patterns are identical to those produced by modern horses when crib-biting. However, it is difficult to prove categorically that these patterns were produced by crib-biting.

1.3 Two Approaches to Environmental Enrichment

The study and implementation of environmental enrichment has been dominated by two approaches since its inception: the naturalistic approach, that relies upon creating the wild environment in captivity to provide stimulation for captive

animals (Forthman-Quick, 1984; Hutchins *et al*., 1984; O'Neill *et al*., 1991; Ogden *et al*., 1993; Wormell & Brayshaw, 2000), and behavioural engineering, which relies upon providing devices and machines that animals operate to receive some form of reward, usually food. Scientists who favour the different approaches have often been critical of each other (Forthman-Quick, 1984). Those who favour the naturalistic approach have suggested that the behavioural engineers only succeed in promoting the performance of abnormal behaviours. Those who favour the behavioural engineering approach have countered that the provision of natural stimuli does nothing to establish the all important connection between behaviour and its natural end point, i.e. consummatory behaviour such as feeding. Forthman-Quick (1984) has pointed out that these two approaches to environmental enrichment are not dichotomies or even opposite ends of a spectrum, merely different but compatible approaches to environmental enrichment. In truth, these approaches tend to reflect the academic backgrounds of their main proponents. The important thing is not to focus on whether one approach is better than the other but to investigate what each approach can contribute to the enrichment of the lives of captive animals.

1.3.1 Naturalistic approach

The origin of the naturalistic approach is found in the work of Carl Hagenbeck and his development of Hamburg Zoo in 1907. Hagenbeck was a great admirer of landscape paintings and wished to create large moated animal enclosures that reminded him of his favourite paintings (Tudge, 1992). Thus, the love of art created a new style of zoo animal enclosure, one that eventually lead to the naturalistic approach to environmental enrichment.

The naturalistic approach seeks to recreate a visually accurate abstract of the species' natural environment in captivity (Figure 1.1). Much animal behaviour results from the presentation of external stimuli. A wild bird sees a predator and then responds by hiding in a bush or a male fish sees a female during the breeding season and then proceeds to court her, for example. The naturalistic approach principally relies on stimulating this type of behaviour. However, it has been argued, and demonstrated experimentally, that for many of these types of behaviours out-of-sight is out-of-mind (Duncan & Petherick, 1991). Thus, how much does it matter if such behaviours are not expressed? The answer to this depends on how much internal motivation has to perform such behaviour patterns. In the case of anti-predatory behaviour it is unlikely that the animal has any internal motivation to express the behaviour, unless a predator is present. However, the performance of courtship behaviour may also depend on internal motivation, i.e. the hormonal activation of this behaviour in response to increasing day length, for example.

A considerable number of behaviour patterns result from internal stimuli. A hungry pig is motivated to express foraging behaviour but a satiated pig presented with food will not forage or feed, for example. Thus, without the presence of any

Figure 1.1 Birds in a naturalistic enclosure (© Robert J. Young).

external stimulus, animals are still motivated to express certain types of behaviour patterns, e.g. principally those behaviour patterns that restore physiological homeostasis, drinking, eating, etc. The motivation to express such behaviour patterns is only abated when the animal can express appetitive behaviour that leads to appropriate consummatory behaviour (see below).

Naturalistic environments are most important in zoos that are focussing on environmental education. The value of a naturalistic environment is that in the zoo-visitor's mind it links the animal with its natural environment (Kreger *et al.*, 1998). It is only by conserving environments that we can hope to conserve the animal species that live within them – this is the critical conservation message that zoos are trying to make.

1.3.2 Behavioural engineering

The first person to suggest the use of the behavioural engineering approach to environmental enrichment was the great primatologist Robert Yerkes. In 1925 he suggested that devices could be installed into primate enclosures that would encourage play and work. This suggestion was later repeated by Hediger in 1950 (Shepherdson *et al.*, 1998) but it was not until the 1970s that this approach was championed by Markowitz (1982). This behavioural engineering approach seeks to restore the natural contingency between the emission of appetitive behaviour (e.g. foraging) and the performance of consummatory behaviour (e.g. feeding). In 1988, Hughes and Duncan pointed to the fact that captive animals often have a need (they termed it a 'behavioural need') to express appetitive patterns of behav-

Figure 1.2 A highly artificial looking gorilla enclosure but one that is functional for the animals (© Robert J. Young).

iour. Furthermore, they suggest from their review of literature that if such a behavioural need is thwarted the welfare of the animal will suffer.

Often, environmental enrichment devices appear to be highly artificial; however, the appearance (i.e. physical form) of the behaviour expressed may be the same as if the behaviour were being naturally stimulated in the wild (Figure 1.2). Williams *et al.* (1996) used a series of wires and pulleys to make a dead rabbit move through a cheetah enclosure at high speed. The device itself looked obviously man-made but the behaviour it stimulated was completely natural looking. The problem is getting the observer to divorce the image of the enrichment device from the image of the behaviour. This is important in zoos where the use of artificial devices can dilute the educational opportunities of an enclosure (Kreger *et al.*, 1998). The physical appearance of environmental enrichment devices for laboratory, farm or pet animals is not important (except in the case of pets where it must look attractive to the buyer). Veasey *et al.* (1996b) explain that humans use running machines for exercise, these machines allow the full and natural appearance of this behaviour. In the case of animals, Young *et al.* (1994) devised a foraging device for farm-housed pigs – the device was a large white ball that dispensed food in response to natural foraging behaviour being directed at it, i.e. rooting. Of course, some environmental enrichment devices are completely artificial and have no relation to the species natural behaviour. For example, a number of primate species have been taught to play and control computer games using a joystick (Platt & Novak, 1997; Washburn *et al.*, 1994). Despite this type of environmental enrich-